ACROLEIN

Acrolein is a federal hazardous air pollutant and was identified as a toxic air contaminant in April 1993 under AB 2728.

CAS Registry Number: 107-02-8 $H_2C=CHCHO$

Molecular Formula: C_3H_4O

Acrolein is a colorless or yellowish, flammable liquid with an unpleasant, extremely pungent odor. It is soluble in petroleum ether, water, and alcohol and miscible with hydrocarbons, acetone, and benzene (Sax, 1989). Acrolein polymerizes (especially in the presence of light, alkali, or strong acid) forming disacryl, a plastic solid (Merck, 1989).

Physical Properties of Acrolein

Synonyms: acraldehyde; allyl aldehyde; acrylic aldehyde; Biocide; 2-propenal

Molecular Weight:	56.06
Boiling Point:	52.5 ^oC
Melting Point:	-88.0 ^oC
Flash Point:	-18 ^oC (< 0 ^oF) (open cup)
Vapor Density:	1.94 (air = 1)
Vapor Pressure:	210 mm Hg at 20 ^oC
Density/Specific Gravity:	0.8389 at 20/4 ^oC
Log Octanol/Water Partition Coefficient:	-0.09
Water Solubility:	208,000 mg/L at 20 ^oC
Henry's Law Constant:	4.4 x 10^{-6} atm-m^3/mole
Conversion Factor:	1 ppm = 2.29 mg/m^3

(Howard, 1990; HSDB, 1991; Merck, 1989; U.S. EPA, 1994a)

SOURCES AND EMISSIONS

A. Sources

Acrolein is emitted from sources where it is manufactured and used as an intermediate for glycerine, methionine, glutaraldehyde, and other organic chemicals. It is also found in tobacco smoke, forest fire emissions, and gasoline and diesel exhaust. Acrolein is also a photooxidation product of various hydrocarbons including 1,3-butadiene (Howard, 1990).

The primary stationary sources that have reported emissions of acrolein in California are paper mills, and abrasive, asbestos, miscellaneous non-metallic mineral, and wood products (ARB, 1997b). Acrolein has been detected but not quantified in motor vehicle exhaust by the Air Resources Board (ARB) (ARB, 1995e).

Acrolein is a registered pesticide in California. It is registered as an antimicrobial and is used to control fungi and bacteria in secondary oil recovery injection systems. Acrolein is also registered as an algicide and herbicide for control of algae and water borne weeds in lakes, ponds, reservoirs, and other aquatic areas. The licensing and regulation of pesticides for sale and use in California are the responsibility of the Department of Pesticide Regulation (DPR). Information presented in this fact sheet regarding the permitted pesticidal uses of acrolein has been collected from pesticide labels registered for use in California and from DPR's pesticide databases. This information reflects pesticide use and permitted uses in California as of October 15, 1996. For further information regarding the pesticidal uses of this compound, please contact the Pesticide Registration Branch of DPR (DPR, 1996).

B. Emissions

The total emissions of acrolein from stationary sources in California are estimated to be at least 40,000 pounds per year, based on data reported under the Air Toxics "Hot Spots" Program (AB 2588) (ARB, 1997b).

C. Natural Occurrence

Acrolein and aldehydes are reported to be common products of a variety of microbial and vegetative processes. Acrolein is also found as a volatile component of essential oil extracted from the wood of oak trees (Howard, 1990).

AMBIENT CONCENTRATIONS

No ARB data exist for ambient concentrations of acrolein. However, the United States Environmental Protection Agency (U.S. EPA) has compiled information from 1961 to 1980 for two urban locations that reported a mean concentration of 14.3 micrograms per cubic meter ($\mu g/m^3$) or 6.2 parts per billion (ppb) with a range of concentrations from 8.2 to 24.6 $\mu g/m^3$ or 3.6 to 10.7 ppb (U.S. EPA, 1993a).

INDOOR SOURCES AND CONCENTRATIONS

The major sources of acrolein in the indoor environment are cigarettes and wood smoke (Hodgson and Wooley, 1991). Acrolein was measured in 59 of 128 homes studied in Woodland, California. The average indoor concentration of acrolein was reported as 7.1 $\mu g/m^3$ with a standard error of 1.7 $\mu g/m^3$. No outdoor concentrations of acrolein were reported in this study (Sheldon et al, 1992).

ATMOSPHERIC PERSISTENCE

Acrolein exists in the atmosphere in the gas phase. The dominant atmospheric loss process for acrolein is by reaction with the hydroxyl radical. Based on this reaction, the atmospheric half-life and lifetime of acrolein is estimated to be 12 hours and 17 hours, respectively. The reaction products include formaldehyde, glyoxal, and the peroxyacyl nitrate (Atkinson, 1995). Because acrolein has been detected in rainwater, wet deposition may also contribute to its removal from the atmosphere (Howard, 1990).

AB 2588 RISK ASSESSMENT INFORMATION

The Office of Environmental Health Hazard Assessment reviews risk assessments submitted under the Air Toxics "Hot Spots" Program (AB 2588). Of the risk assessments reviewed as of 1996, for non-cancer effects, acrolein contributed to the total hazard index in 14 of the approximately 89 risk assessments reporting a total chronic hazard index greater than 1 and presented an individual hazard index greater than 1 in 9 of these risk assessments. Acrolein also contributed to the total hazard index in 17 of the approximately 107 risk assessments reporting a total acute hazard index greater than 1, and presented an individual hazard index greater than 1 in 2 of these risk assessments (OEHHA, 1996b).

HEALTH EFFECTS

Probable routes of human exposure to acrolein are inhalation and ingestion (HSDB, 1991).

Non-Cancer: Inhalation exposure to acrolein causes irritation of the eyes, nose, throat, and respiratory tract. In severe cases, pulmonary edema may occur (HSDB, 1991; U.S. EPA, 1994a).

An acute Reference Exposure Level (REL) of 2.5 $\mu g/m^3$ and a chronic REL of 0.02 $\mu g/m^3$ is listed for acrolein in the California Air Pollution Control Officers Association Air Toxics "Hot Spots" Program, Revised 1992 Risk Assessment Guidelines. The toxicological endpoint considered for acute and chronic toxicity is the respiratory system (CAPCOA, 1993). The U.S. EPA has established a Reference Concentration (RfC) of 0.02 $\mu g/m^3$ for acrolein. The U.S. EPA estimates that inhalation of this concentration or less, over a lifetime, would not likely result in the occurrence of chronic, non-cancer effects. The U.S. EPA has not established an oral Reference Dose (RfD) for acrolein. However, they have calculated a provisional RfD of 0.02 milligrams per kilogram per day. The U.S. EPA estimates that consumption of this dose or less, over a lifetime, would not likely result in the occurrence of chronic, non-cancer effects (U.S. EPA, 1994a).

Birth defects have only been observed in animal studies where acrolein was injected directly into the embryonic tissue (U.S. EPA, 1994a).

Cancer: No information is available on the carcinogenic effects of acrolein in humans. An increased incidence of adrenocortical tumors in female rats exposed to acrolein in drinking water was reported in one study. The U.S. EPA has placed acrolein in Group C: Possible human carcinogen (U.S. EPA, 1994a). The International Agency for Research on Cancer has placed acrolein in Group 3: Not classifiable (IARC, 1987a).